

by Susanne D. Ellis
and Patrick J. Mulvey

AIP Pub. No. R-282.12

December 1989

EMPLOYMENT SURVEY 1988

The physics education that precedes one's initial employment in physics can range over a period from four to more than ten years depending on the degree level at which graduates decide to interrupt or terminate their studies. The demand for those graduates corresponds to an equally wide range; it is high for those who completed doctorates but only variable for bachelors and masters. A similar, but scaled down, scenario exists for the degree recipients from astronomy programs. Our Employment Survey is conducted annually to monitor the changing demand for graduates and assess the level of satisfaction experienced by both physics and astronomy degree recipients at the bachelor's, master's and doctoral levels. We schedule this survey during the winter, so as to allow six months to elapse between it and two student surveys conducted each summer. It is the summer surveys that identify the employment-oriented physics and astronomy graduates who form the population we target in this follow-up survey.

Among the statistics we provide to academic advisors as well as degree candidates are data on the time spent to secure suitable positions. The three degree levels correspond to a wide range of reported time periods. **Figure I** presents four time periods during which graduates at each of the three degree levels accepted their first positions. 'Postdocs' are excluded from the doctoral graduates so as to focus on potentially permanent positions comparable to those accepted by the masters and bachelors. The first time period—less than one month—is intended to identify graduates who have positions already lined-up when their degrees were conferred. In the class of 1988, the proportion of masters and bachelors who fell into this group showed a decline from the previous year; they comprised 36% and 38%, respectively, compared with the 44% recorded for both groups in 1987. The time periods for doctoral graduates changed little from the previous year.

Figure I. Time spent by 1987-88 physics degree recipients in securing employment.

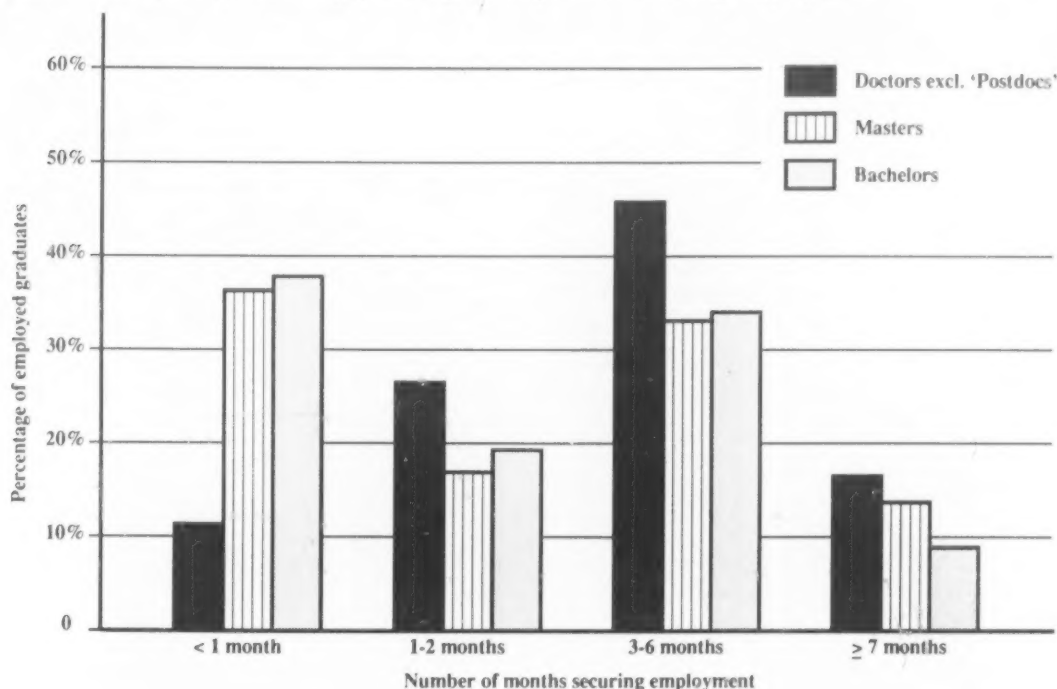


Table I. Changes in occupational status of physics degree recipients between the summer of 1988 and the following winter.

		Occupational status, winter 1988-89				
		'Postdoc' or student	Employment full-time permanent	Other	Not employed and seeking in the U.S.	Total N %
Employment status reported by physics degree recipients, summer 1988.	Doctors					
	Newly accepted employment	8	121	-	1	130 29%
	Continuing employment	3	11	-	-	14 3
	'Postdoc'	232	16	-	-	248 56
	Leave the United States	15	7	-	1	23 5
	Other	6	1	1	3	11 3
	Not employed and seeking	7	7	1	2	17 4
		N	271	163	2	7 443
	Total respondents	%	61	37	0.4	2 100%
	Masters					
	Newly accepted employment	3	80	-	-	83 57%
	Continuing employment	1	23	-	-	24 16
	Leave the United States	1	1	-	-	2 1
	Other	2	10	1	1	14 10
	Not employed and seeking	3	13	-	7	23 16
		N	10	127	1	8 146
	Total respondents	%	7	87	1	5 100%
	Bachelors					
	Newly accepted employment	7	305	7	9	328 40%
	Continuing employment	4	101	11	6	122 15
	Military service	-	131	-	2	133 16
	Summer employment	6	58	6	12	82 10
	Undecided	1	9	6	5	21 3
	Not employed and seeking	15	64	11	43	133 16
		N	33	668	41	77 819
	Total respondents	%	4	82	5	9 100%

Although the degree level is the leading characteristic in determining one's initial employment, other parameters such as subfield, citizenship and geographic region also influence the types of positions new graduates accept. This report analyzes selected employment characteristics for each of six groups of graduates.

Tables I and II focus on the changes in occupational status experienced during the six-month period between the earlier student survey and this follow-up survey. Each table has three parts which correspond to the three degree levels and the data include both U.S. and foreign degree recipients. The first column of each table lists the occupational status as reported by the physics and astronomy graduates in the summer of 1988. Thus the first two rows of Table I indicate that 32% of the physics doctorate recipients secured permanent employment and 56% had accepted 'postdocs'. Those who initially reported "Leaving the U.S." are likely to have referred to a plan that will not take effect for a year or two.

Approximately one third of the 700 physics master's degree recipients in the class of 1988 studied for that degree on a part-time basis while working full-time and continued their employment after graduation. This group is under-repre-

sented in our Employment Survey as shown by the fact that only 24 of the respondents to this year's survey fell into this category; all except one reported no changes in their occupational status. Of the masters who identified themselves as unemployed in the summer survey, a majority secured positions during that six-month period.

When referring to employment-oriented physics bachelors, we need to add a qualifying statement: Approximately one-fifth of that group intends to work for only one year while deciding which graduate studies to pursue. It appears from Table I that 4% of the 819 respondents to this Employment Survey exercised that option earlier than expected. Special attention is paid to the bachelors who were either undecided or unemployed when the summer survey was conducted, but Table I indicates that a majority of both groups had changed their status to some form of employment. It should be noted that some of the 77 bachelors who were seeking employment at the time of this follow-up survey appear to be involved in a job change rather than considering themselves unemployed since graduation.

A well established pattern for astronomy doctorate recipients is to accept postdoctoral fellowships and Table II shows that the class of 1988 follows that tradition. Astron-

Table II. Changes in occupational status of astronomy degree recipients between the summer of 1988 and the following winter.

		Occupational status, winter 1988-89				Total	
		'Postdoc' or student	Employed	Not employed and seeking in the U.S.		N	%
Employment status reported by astronomy degree recipients, summer 1988.	Doctors						
	Regular employment	1	7	-		8	15%
	'Postdoc'	37	1	-		38	72
	Leave the United States	5	1	-		6	11
	Not empl. and seeking	-	1	-		1	2
	Total respondents	N 43	10	-		53	
		% 81	19	-			100%
	Masters						
	Regular employment	-	4	-		4	57%
	Not empl. and seeking	-	2	1		3	43
	Total respondents	N -	6	1		7	
		% -	86	14			100%
Bachelors	Regular employment	-	16	-		16	53%
	Military service	-	6	-		6	20
	Summer employment	-	3	-		3	10
	Not empl. and seeking	-	5	-		5	17
	Total respondents	N -	30	-		30	
		% -	100	-			100%

omy masters and bachelors, who are less likely to identify with that profession, appear to have found suitable employment before this follow-up survey was conducted.

The type of dissertation research is another characteristic that influences the type of initial employment new doctoral physicists accept. Those whose dissertations were based on experimental work were more likely than theoreticians to be offered potentially permanent positions; theoreticians, on the other hand, were more heavily concentrated in postdoc-

toral positions. This interpretation is supported by the subtotals for experimentalists and theoreticians in Table III where 41% of the experimentalists compared with only 31% of the theoreticians accepted permanent employment.

A further detail incorporated into Table III is the citizenship of the doctoral graduates. This analysis indicates that since 1985 U.S. employers have hired an increasing number of foreign theoreticians among the PhD recipients to fill potentially permanent positions in the United States.

Table III. Occupational status of experimental and theoretical physicists by type of dissertation research, 1987-88.

Occupational status		Experimentalists			Theoreticians			Total
		U.S.	Foreign	Sub-total	U.S.	Foreign	Sub-total	
Full-time employed		46%	24%	41%	32%	29%	31%	38%
'Postdoc'		53	73	58	68	65	67	61
Not empl. and seeking		1	3	1	-	6	2	<1
		100%	100%	100%	100%	100%	100%	100%
Total	N	225	72	297	72	49	121	418
	%			71%			29%	100%

Table IV. Characteristics of postdoctoral and full-time employed physics and astronomy doctorate recipients, 1987-88.

Characteristics	Physics		Astronomy		
	'Postdocs'	Full-time employed	'Postdocs'	Full-time employed	Characteristics
<u>Sex</u>					<u>Sex</u>
Female	9%	5%	19%	-	Female
Male	91	95	81	100%	Male
<u>Age</u>					<u>Age</u>
26 or younger	4%	4%	9%	-	26 or younger
27 years	10	7	12	10%	27 years
28 years	17	18	28	30	28 years
29 years	22	14	16	20	29 years
30 years	14	15	19	-	30 years
31-32 years	16	14	11	20	31-32 years
33 or older	17	28	5	20	33 or older
<u>Citizenship</u>					<u>Citizenship</u>
U.S.	65%	77%	67%	80%	U.S.
Foreign	35	23	33	20	Foreign
<u>Type of research</u>					<u>Type of research</u>
Experimental	67%	75%	65%	90%	Observational
Theoretical	33	25	35	10	Theoretical
<u>Major subfield of dissertation</u>					<u>Major subfield of dissertation</u>
Astrophysics	7%	7%	9%	-	Astrophysics
Condensed matter	34	32	26	50%	Cosmology/extragalactic/ quasi-stellar objects
Electron/atomic/molecular	8	11			Interstellar matter & gaseous nebulae
Elementary particles	18	12	16	10	Stellar atmospheres and spectra/ stellar evolution/solar and stellar interiors
Nuclear physics	10	10			Solar systems
Optics/lasers	3	6	23	10	The sun
Plasma/fluids/chaos	8	9	2	10	
			5	10	
Median monthly salary	\$2210	\$3340	\$2000	\$2900	
Number of respondents	271	163	43	10	

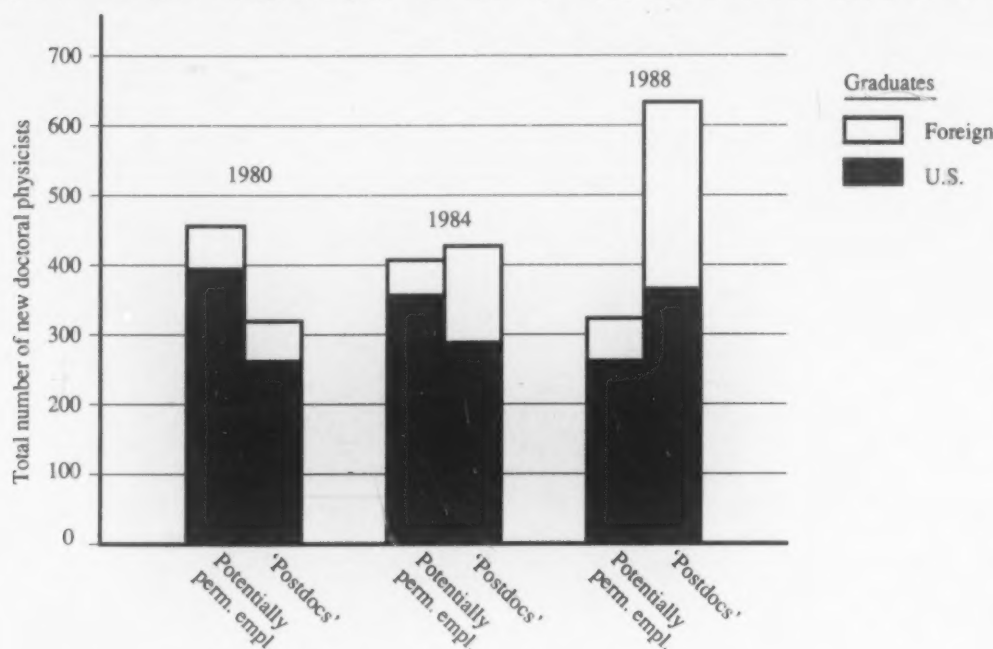
Each of the first three tables distinguishes between temporary postdoctoral and permanent full-time initial employment. Table IV carries this analysis one step further by examining six characteristics of physicists and astronomers to see which ones continue to influence the type of initial employment. For example, both astronomers and physicists who accepted 'postdocs' include greater proportions of women, foreign citizens and theoreticians; the 'postdocs' are also younger and work for lower salaries. In scrutinizing these data more closely one should keep in mind that the responses of physicists to astronomers form a ratio of ten-to-one.

In 1980 the People's Republic of China began to permit students to enroll in graduate physics programs, among others, in the U.S., an act that had a major impact on our educational system. The time it took those students to complete doctorates depended on how much credit they received for course work they completed abroad; thus by entering doctoral programs with advanced standing, some of the Chinese students needed only two or three years of study (instead of six years) and thus became part of the doctorate recipients of the early 1980s. The enrollment of other foreign graduate physics students has fluctuated since the 1970s whereas the students from Mainland China increased steadily from year to year; by 1988 they comprised the largest

single group of foreign physics doctorate recipients. This scenario made U.S. employers wonder whether foreign doctoral graduates will contribute to the research efforts in this country. A question to that effect was included in our surveys which indicate that a majority of the doctorate recipients expressed a preference for staying in the U.S. for a limited time. Figure II illustrates the resulting employment pattern by choosing three representative years starting with 1980 when the foreign doctorate recipients included none from Mainland China and only an estimated 55 foreign graduates who had accepted 'postdocs' in the U.S. By 1984 the number of foreign 'postdocs' more than doubled while U.S. citizens interested in 'postdocs' increased only by 10%. By 1988 a complete reversal of the initial employment pattern had taken place; not only did the total number of new 'postdocs' increase by 50%, but also more U.S. degree recipients chose 'postdocs' over potentially permanent employment.

Figure II also shows that a small but stable number of foreign graduates were offered potentially permanent positions in the U.S. between 1980 and 1988. This number is likely to remain small because offers of permanent positions to graduates on student visas oblige the employers to go to the expense and inconvenience of getting the student visas changed to those for permanent residents.

Figure II. Changes in the type of employment accepted by new physicists in the U.S., 1980, 1984, 1988.



SOURCE: Graduate Student Survey, AIP Pub. No. R-207

Another comparison between the two types of initial employment involves the subfield mobility. Table V shows that the probability of working in the subfield of one's dissertation is far greater for the 'postdocs' than it is for doctoral graduates who had accepted potentially permanent positions. The first column of Table V lists the major dissertation subfields and matches them with the subfields associated with the physi-

cists' initial employment. Thus we find the large percentages along the diagonal in the upper portion of the table which presents data on the postdoctoral fellowships; by contrast the lower half of this table illustrates the adaptability of new physicists whose permanent positions are spread among a larger number of specialties.

Table V. Subfield mobility of new doctoral level physicists, 1987-88.

Major subfield of dissertation	Subfields of 'postdoc'							Total respondents
	Astrophysics	Condensed matter	Electron/atomic/molecular	Elementary particles	Plasma/fluids/chaos	Nuclear physics	Other	
Astrophysics	64%	-	-	21%	5%	5%	5%	19
Condensed matter	-	80%	1%	-	2	2	15	87
Electron/atomic/molec.	-	5	70	-	5	5	15	20
Elementary particles	2	-	-	80	-	4	14	45
Plasma/fluids/chaos	9	-	-	-	82	-	9	22
Nuclear physics	-	-	-	9	-	75	16	24
								217

Major subfield of dissertation	Subfields of potentially permanent employment								Total respondents
	Condensed matter	Education	Elec./atom./molec.	Elem. part.	Nuclear	Optics	Plasma/fluids/chaos	Applied physics	
Applied physics	12%	12%	-	-	-	24%	-	41%	17
Condensed matter	59	4	-	-	-	10	-	20	49
Electron/atomic/molec.	-	-	29%	-	-	29	12%	-	17
Elementary particles	5	21	-	11%	5%	-	-	11	47
Nuclear physics	-	13	-	-	38	-	-	6	43
Plasma/fluids/chaos	7	-	14	-	-	-	50	14	15
									132

Table VI. Employment with potential permanence accepted by 1987-88 physics doctorate recipients.

		Type of employer						Total	
		Univ.	Coll.	Industry	Gov't.	Fed. fund. res. ctr.	Nonprofit org.	N	%
Subfield of PhD	Astrophysics	3	2	5	1	-	1	12	7%
	Condensed matter	10	3	22	7	6	1	49	31
	Electron/atomic/molec.	2	2	8	4	1	-	17	11
	Elementary particles	7	2	5	-	5	-	19	12
	Nuclear physics	7	1	6	1	1	-	16	10
	Optics/lasers	1	1	5	2	-	-	9	6
	Plasma/fluids/chaos	3	1	3	2	5	-	14	9
	Other	5	3	7	5	1	1	22	14
Work activity	Teaching	16	12	-	-	-	-	28	18%
	Research	18	2	11	7	9	2	49	31
	Res./dev./des.	2	-	42	15	9	1	69	44
	Other	2	1	8	-	1	-	12	7
Utilization	Related to physics	36	15	54	22	18	3	148	94%
	Unrelated to physics	2	-	7	-	1	-	10	6
Interested in a job change	Yes	16	8	20	6	6	1	57	36%
	No	20	7	32	13	11	2	85	54
	Unsure	2	-	9	3	2	-	16	10
Starting salary	Monthly median	\$2500	\$2250	\$3800	\$3090	\$3750	*	153	\$3330
Total respondents	N	38	15	61	22	19	3	158**	
	%	24	9	39	14	12	2		100%

*Insufficient data.

**An additional five new doctoral physicists began their employment outside the U.S.

Table VII. Characteristics of 1987-88 physics masters related to the type of employment secured.

		Type of employer						
Characteristics		Ed. inst.	Industry manuf. service	Civilian government	Military service	Not empl. and seeking	Total	
Sex	Female	24%	4%	12%	28%	6%	-	14%
	Male	76	96	88	72	94	100%	86
Age	24 or younger	18%	6%	25%	28%	11%	38%	16%
	25-26 years	35	42	44	16	11	-	30
	27-28 years	12	16	25	16	22	12	18
	29-30 years	12	10	-	4	28	-	9
	31 or older	23	26	6	36	28	50	27
Citizenship	U.S.	100%	92%	100%	100%	100%	75%	95%
	Foreign	-	8	-	-	-	25	5
Type of graduate inst.	Public	94%	82%	75%	88%	78%	75%	83%
	Private	6	18	25	12	22	25	17
Type of employment	Physics related	100%	86%	69%	83%	83%	-	85%
	Unrelated to physics	-	14	31	17	17	-	15
Major subfield of degree	Applied physics	12%	14%	6%	26%	6%	23%	14%
	Condensed matter	18	26	6	9	22	23	19
	Cross disciplinary	18	14	13	9	6	23	13
	Optics	-	22	13	39	17	8	19
Major work activity	Res./dev./des.	47%	66%	56%	57%	50%	-	51%
	Data analysis	-	24	44	26	28	-	25
	Teaching	41	4	-	-	6	-	8
Median monthly salary		\$2130	\$2820	\$2630	\$2500	*	-	\$2580
Total		10%	40%	15%	17%	13%	5%	100%

*Insufficient data.

Tables VI through IX concentrate on initial employment with potential permanence by relating pertinent characteristics of physics doctors, masters and bachelors to major types of U.S. employers. Since background characteristics of physics doctorate recipients were already included in Table IV, we examine in Table VI the answers to questions concerning the degree of satisfaction with new positions, the utilization of the new physicists' training and their work activities among other characteristics. In comparison with the previous year we find an increase in the proportion of physicists who accepted tenurable teaching positions at universities; the 16 respondents shown in Table VI compare with only 6 in that category one year earlier. The proportion of new physicists in industry decreased by 13 percentage-points as all other types of employers showed small increases.

Background characteristics as well as those pertaining to the current employment of new physics masters are presented in Table VII. The three major types of employers included subdivisions for industry and the government so as not to obscure differences in the characteristics of the masters. For example, very few women with physics master's degrees enter the military; they are also under-represented in the manufacturing sector of industry. Other conspicuous differ-

ences highlighted by Table VII include the utilization of the graduates' physics training and the salaries paid by different types of employers. Almost one-third of the positions in service industries are unrelated to physics; on the other hand, all the new masters who had accepted positions at educational institutions reported using their physics training, but received salaries that were 17% below the median monthly salary of \$2580.

Each year the physics bachelors form the largest group of respondents to this follow-up survey; hence we present their analysis in two tables. Table VIII focuses on how eight characteristics of the graduates relate to specific employers, whereas Table IX examines employer characteristics best illustrated in terms of horizontal percentages. Since employment-oriented graduates at the bachelor's level are not very mobile, the region of initial employment, for most of the graduates, is also the region of their undergraduate institutions. Having shown in Figure I how long it took physics bachelors to secure employment, we elaborate on these data in Table VIII by listing the methods they used and what proportion of the bachelors received multiple job offers to choose from. New bachelors who work in a service industry recorded the highest proportion of graduates (61%) whose work is unrelated to physics.

Table VIII. Characteristics of 1987-88 physics bachelors related to type of employment secured.

Characteristics		Type of employer								Total N %	
		Sec. school	Coll./ univ.	Industry manuf. serv.		Civil. gov't.	Military service	Nonprf. org.	Not empl.		
Sex	Female	17%	16%	18%	22%	23%	10%	39%	17%	137	19%
	Male	83	84	82	78	77	90	61	83	602	81
Age	22 or younger	33%	27%	32%	32%	26%	49%	33%	23%	239	32%
	23 years	47	20	29	25	29	27	39	31	211	29
	24-25 years	6	17	18	23	26	14	17	25	148	20
	26 or older	14	36	21	20	19	10	11	21	141	19
Type of employment	Physics related	69%	68%	61%	39%	65%	44%	67%	-	348	52%
	Unrelated to physics	31	32	39	61	35	56	33	-	318	48
Number of job offers	1	47%	58%	56%	45%	56%	81%	56%	20%	380	57%
	2	17	26	23	36	33	10	17	-	166	25
	>3	36	16	21	19	11	9	27	-	120	18
Region of employment	Northeast	42%	19%	28%	33%	18%	-	28%	-	135	26%
	Southeast	14	7	13	15	36	-	28	-	93	18
	Central/Mountain	39	48	38	31	22	-	22	-	174	34
	Pacific	5	26	21	21	24	-	22	-	116	22
Major work activity	Res./dev./des.	3%	53%	62%	37%	54%	15%	44%	-	233	35%
	Data analysis	-	10	16	28	27	7	7	-	120	18
	Teaching	97	13	-	2	7	5	22	-	73	11
Primary method which secured employment	Univ. placement	15%	10%	20%	13%	18%	5%	11%	-	93	14%
	Resumes	58	32	38	41	32	12	50	-	233	35
	Contacts/faculty	18	55	27	30	32	2	33	-	166	25
	Military	-	-	-	-	1	80	-	-	120	18
Level of experience	Newly accepted	100%	94%	91%	91%	91%	15%	94%	-	586	88%
	Cont. employment	-	6	9	9	9	85	6	-	80	12
Total respondents	N	37	31	183	181	68	148	18	73	739*	
	%	5	4	25	25	9	20	2	10		100%

*This total does not include 8 bachelors with foreign employers and 33 respondents who chose graduate study after exploring the job market.

Table IX. Selected characteristics of physics bachelors that effect their employment, 1988.

Characteristics		Type of employer								Totals		
		Sec. school	Coll./ univ.	Industry/ manuf.	serv.	Civil. gov't.	Military	Nonprf. org.	Not empl.			
Sex	Female	5%	4%	26%	30%	12%	8%	5%	10%	100%	128	17%
	Male	5	4	25	23	8	22	2	11	100	605	83
Type of bachelor's institution	Public	4%	3%	24%	22%	9%	26%	1%	11%	100%	489	66%
	Private	7	6	27	28	9	9	4	10	100	247	34
Type of degree	BS	4%	4%	26%	23%	9%	21%	2%	11%	100%	569	77%
	BA	7	6	21	28	10	18	4	6	100	166	23
Median monthly salary		\$1500	\$1550	\$2250	\$2000	\$2000	\$1500	\$2000	-	All employers \$1920		

Table X. Median monthly salaries paid by civilian employers to physics bachelors, 1988.

		Work activity						All employers combined
		Res./dev./ design	Data anal./ progr.	Technician/ res. asst.	Teaching	Tech. writing/ sales	Nonphysics prof'l work	
N = 485								
Salary	\$2300	\$2070	\$1700	\$1540	\$2400	\$2000	\$1300	\$2000
% respondents	32	22	24	10	4	3	5	100%

To see what influence the type of institution, the type of degree or the graduate's sex has on his or her initial employment, we turn to **Table IX** which indicates that academic institutions employ proportionately more bachelors from private than public institutions and favor graduates with arts rather than science degrees. Women appear to be equally accepted by most of the employers as their proportion among the physics bachelors has levelled off. Approximately 10% of the employed bachelors reported salaries for the first time because they had been unemployed when the earlier survey was conducted. Apparently, their salaries had the effect of lowering the medians for each type

of employer. Yet their overall median salary of \$1920 compares favorably with that of the astronomy bachelors who reported a median salary of \$1750.

But a more relevant presentation of bachelors' salaries is to relate them to the different work activities bachelors report and exclude the military. Thus **Table X** shows that one-third of the bachelors are engaged in research, development or design work at a median salary of \$2300 which is well above the median of \$2000 paid by all civilian employers combined.

Table XI. Time spent by 1987-88 astronomy graduates in securing employment.

	Number of months spent seeking employment		Total respondents
	<2 months	>3 months	
Astronomy bachelors	17	13	30
Astronomy masters	2	5	7
Astronomy 'postdocs'	11	32	43
Regularly employed astronomers	5	5	10

Table XI supplements the information on astronomy graduates presented in two earlier tables of this report. It focuses on the amount of time spent by four groups of degree recipients before they secured employment. It is generally

assumed that postdoctoral fellowships are in great supply and readily available; yet three out of four new astronomers required at least three months to find an appropriate one.